

WHAT IS CLAIMED IS:

1. An audio enhancement system uniquely adapted for use in a near-field audio reproduction system such as a portable stereo system or a multimedia computer system comprising:

a first high-pass filter which receives a first input, the first high-pass filter configured to filter a set of lower frequencies in the first input relative to other frequencies in the first input;

a second high-pass filter which receives a second input, the second high-pass filter configured to filter a set of lower frequencies in the second input relative to other frequencies in the second input;

a difference circuit that receives the filtered left and right inputs supplied by an audio reproduction system, wherein the difference circuit identifies difference information in the left and right inputs;

an equalizer in communication with the difference circuit, the equalizer configured to modifying the frequency response of the difference information to create processed difference information having a level of equalization varying with respect to the frequency component of the processed difference information, wherein the level of equalization is adapted to exploit the acoustics of a human ear and especially those unique to a near-field audio system, the level of equalization comprising:

a maximum gain occurring at a maximum-gain frequency of approximately 100 to 150 Hz, a minimum gain occurring at a minimum-gain frequency of approximately 1680 to 2520 Hz, and a mid-gain of approximately one-half the difference between the maximum gain and the minimum gain occurring at a mid-gain frequency of approximately 5600 to 8400 Hz;

bass attenuation of the difference information relative to the maximum gain, the bass attenuation occurring below the maximum-gain frequency and increasing with a reduction in difference-information frequency to prevent overamplification of a speaker; and

mid-range attenuation of the difference information relative to the maximum gain, the mid-range attenuation occurring above the maximum gain frequency and increasing with a corresponding increase in difference-information frequency up to the minimum-gain frequency, the mid-range attenuation decreasing above the minimum-gain frequency with an increase in difference-information frequency up to the mid-gain frequency; and

a summing circuit that combines the processed difference information with at least a portion of the set of lower frequencies in the left input to create an enhanced left output, the summing circuit also configured to combine the processed difference information with at least a portion of the set of lower frequencies in the right input to create an enhanced right output.

2. The audio enhancement system of claim 1 wherein the difference circuit, the equalizer and the summing circuit are implemented in a digital signal processor.

3. The audio enhancement system of claim 1 wherein the bass attenuation increases at a rate of approximately 6 decibels per octave, the mid-range attenuation is increasing below the minimum-gain frequency at a rate of approximately 6 decibels per octave, and the mid-range attenuation is decreasing above the minimum-gain frequency at a rate of approximately 6 decibels per octave.

4. The audio enhancement system of Claim 1 further comprising an attenuator that attenuates the difference information by a fixed amount substantially across an audible frequency spectrum.

5. The audio enhancement system of Claim 1 further comprising a first bass filter connected between the left input and the difference circuit, and a second bass filter connected between the right input and the difference circuit, the first and

second bass filters attenuating very low frequency components of the left and right original inputs.

6. The audio enhancement system of Claim 5 wherein the first and second bass filters are implemented in a digital signal processor.

7. The audio enhancement system of Claim 6 wherein the first and second bass filters have a cutoff frequency in the range of 125 to 200 Hz.

8. The apparatus of Claim 1 further comprising a level adjust circuit in communication with the difference circuit, the level adjust circuit configured to adjust the level of the difference information.

9. An apparatus for enhancing sound, the apparatus comprising:
- a first high-pass filter which receives a first input, the first high-pass filter configured to filter a set of lower frequencies in the first input relative to other frequencies in the first input;
  - a second high-pass filter which receives a second input, the second high-pass filter configured to filter a set of lower frequencies in the second input relative to other frequencies in the second input;
  - a difference circuit in communication with the first and second high-pass filters, the difference circuit configured to identify the difference information in the filtered first and second inputs;
  - an equalizer in communication with the difference circuit, the equalizer configured to spectrally shape the difference information; and
  - a summing circuit in communication with the equalizer and the first input and the second input, the summing circuit configured to combine the spectrally shaped difference information with the set of lower frequencies in the first input to generate a first output, the summing circuit further configured to combine the spectrally shaped difference information with the set of lower frequencies in the second input to generate a second output.

10. The apparatus of Claim 9 wherein the difference information is spectrally shaped by the equalizer by applying a perspective curve characterized by a maximum gain within a first frequency range of 100 to 150 Hz and the curve characterized by a minimum gain within a second frequency range of 1680 to 2520 Hz, wherein the curve decreases at a rate of approximately 6 decibels per octave below the first frequency range and above the first frequency range towards the second frequency range, the curve further increasing at a rate of approximately 6 decibels per octave above the second frequency range.

11. The apparatus of Claim 10 wherein the maximum gain and the minimum gain are separated by approximately 12 decibels.

12. The apparatus of Claim 10 wherein the perspective curve is adjustable to raise or lower the maximum and minimum gain frequencies with the maximum gain range and the minimum gain range.

13. The apparatus of Claim 9 further comprising a level adjust circuit in communication with the difference circuit, the level adjust circuit configured to adjust the level of the difference information.

14. The apparatus of Claim 9 wherein the first and second high-pass filters, the difference circuit, the equalizer, and the summing circuit are implemented in a digital signal processor.

15. The apparatus of Claim 9 further comprising an attenuator that attenuates the difference information by a fixed amount substantially across an audible frequency spectrum.

16. An apparatus for enhancing sound, the apparatus comprising:  
a first input and a second input wherein the first and second inputs comprise at least a set of lower frequencies relative to other frequencies;

a difference circuit configured to identify difference information in the first and second inputs;

an equalizer configured to spectrally shape the difference information in the first and second inputs, wherein the difference information spectrally shaped by the equalizer does not spectrally shape the set of lower frequencies; and

a summing circuit configured to combine the spectrally shaped difference information with at least a portion of the set of lower frequencies in the first input to generate a first output, a summing circuit further configured to combine the spectrally shaped difference information with at least a portion of the set of lower frequencies in the second input to generate a second output.

17. The apparatus of Claim 16 wherein the difference information is spectrally shaped by the equalizer by applying a perspective curve characterized by a maximum gain within a first frequency range of 100 to 150 Hz and the curve characterized by a minimum gain within a second frequency range of 1680 to 2520 Hz, wherein the curve decreases at a rate of approximately 6 decibels per octave below the first frequency range and above the first frequency range towards the second frequency range, the curve further increasing at a rate of approximately 6 decibels per octave above the second frequency range.

18. The apparatus of Claim 17 wherein the maximum gain and the minimum gain are separated by approximately 12 decibels.

19. The apparatus of Claim 17 wherein the perspective curve is adjustable to raise or lower the maximum and minimum gain frequencies with the maximum gain range and the minimum gain range.

20. The apparatus of Claim 16 further comprising a level adjust circuit in communication with the difference circuit, the level adjust circuit configured to adjust the level of the difference information.

21. The apparatus of Claim 16 wherein the a high-pass filter, difference circuit, the equalizer, and the summing circuit are implemented in a digital signal processor.

22. The apparatus of Claim 16 further comprising an attenuator that attenuates the difference information by a fixed amount substantially across an audible frequency spectrum.

23. An apparatus for enhancing sound, the apparatus comprising:  
receiving a first input and a second input, wherein the first and second inputs comprise at least a set of lower frequencies relative to other frequencies;  
a difference circuit configured to identify a difference information in the first and second inputs;  
spectrally shaping the difference information while not spectrally shaping the set of lower frequencies; and  
combining the spectrally shaped difference information with the set of lower frequencies to generate an output that contains the spectrally shaped difference information and at least a portion of the set of lower frequencies.

24. The method of Claim 23 wherein spectrally shaping the difference information boosts the amplitudes of a second set of frequencies relative to the amplitudes of the set of lower frequencies, the second set of frequencies occurring at higher frequencies than the set of lower frequencies.

25. The method of Claim 24 wherein a maximum boost of the second set of frequencies occurs at approximately 125 hertz.

26. The method of Claim 24 wherein spectrally shaping the difference information further reduces the amplitudes of a third set of frequencies relative to the

amplitudes of the second set of frequencies, the third set of frequencies occurring at higher frequencies than the second set of frequencies.

27. The method as defined in Claim 26 wherein a maximum reduction of the amplitudes of the third set of frequencies occurs at approximately 2.1 kilohertz.

28. The method of Claim 26 wherein the act of spectrally shaping the difference information further boosts the amplitudes of a fourth set of frequencies relative to the amplitudes of the third set of frequencies, the fourth set of frequencies occurring at higher frequencies than the third set of frequencies.

29. The method as defined in Claim 28 wherein a maximum boost of the amplitudes of the fourth set of frequencies occurs above approximately 2.1 kilohertz.